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A comprehensive multi sensor study of spatio-temporal variation of hail occurrence and their size over the north eastern part of India

Sanjay Sharma [(1)], Partha Roy[(1)], Rupraj Biswasharma[(1)], Ashish Kumar [(2)]
Kohima Science College, Jotsoma, Kohima, Nagaland-797002,
e mail: sanjay_sharma11@hotmail.com, partharampurhat@gmail.com, ruprajaus@gmail.com
2 Regional Meteorological Centre, Guwahati -7810151, email: ashish051085@gmail.com

A study of spatial and temporal variation of hail occurrences and their size is carried out over the north-eastern part of India (23 – 29 ^{0}N and 89-100 ^{0}E) during the pre-monsoon season (March-May). For this purpose, thirty four years of ground report data of hail occurrence (1985-2018) and four years of their size (2015-2018) at eleven meteorological stations of India Meteorological Department are utilized. The hail events are analyzed in association with the multi sensor observations. A near simultaneous radar reflectivity profile observations from Ku band precipitation radar on TRMM and GPM satellites are considered. Thermal infrared imager (TIR 11.3 μm) on INSAT-3D, along with the Doppler Weather Radar (DWR) at Agartala and Dibrugarah (Mohanbari) stations are utilized to study the life cycle of hail storms. The ice microphysical properties in the mixed phase region are studied by CloudSat observations. The nearby radiosonde observations are utilized to study the instability condition of the atmosphere during hail events.

Though the majority of hail storms are reported over Shillong, Guwahati, Dhubri, Tezpur and Agartala, stations, but the significant contribution of severe hail (≥ 20 mm) is reported at Agartala, where the maximum reported size of the hail is 63 mm. Majority of hail storms are reported during afternoon and evening hours. With reference to the elevation of the hail reporting stations, significant variation in the morphology of the reflectivity profiles is observed. Over Agartala, the mean radar reflectivity profiles show that 40 dBZ echo top height reaches up to 6.5 km above the freezing level (4.75 km). During a life cycle study of a hail storms over Agartala, at 0.5^o elevation imageries, the maximum radar reflectivity is found to be around 55 dBZ. During severe hail storms, the brightness temperature of thermal infrared imager of INSAT-3D goes as low as 130 K. The ice microphysical properties are consistent with the hail events, i.e. the regions of significant hail are associated with the larger ice effective radius and higher ice water content in the mixed phase region. With respect to hail storms, the near simultaneous radiosonde observations revels high convective available potential energy.